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A Model of Adjustment and Growth: An Empirical Analysis

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Abstract

This paper develops a model merging the monetary approach to the balance of payments and a neoclassical growth model into a unified framework in which inflation, growth, and the balance of payments are simultaneously determined. The empirical part of the paper presents estimates of the key parameters of the model for a sample of seven diverse developing countries and tests the validity of a subset of the theoretical assumptions. The estimated model is then used for a variety of comparative static exercises, including the effects of fiscal and monetary policy changes, and devaluation.

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Contents

I. Introduction

The concept of "growth-oriented adjustment", or the notion that economic growth is essential for the achievement of the twin goals of a sustained reduction in inflation and a viable balance of payments, has recently received the attention of policymakers and academics alike. Indeed, growth-oriented adjustment is considered a key characteristic of the policy packages that make up Fund-supported programs. Examples of the blossoming literature on the subject of growth-oriented adjustment can be found in Corbo, Goldstein, and Khan (1987). 1/

Any analysis of the effects of policies on the multiple targets of growth, inflation, and the balance of payments requires a consistent and unified framework. Further, because this issue is particularly relevant for developing countries, it is desirable that this framework be sufficiently simple so as to allow its application to countries in which data availability is limited, and at the same time be general enough to ensure its applicability to a diverse set of countries. The model developed by Khan and Montiel (1988), which merges a variant of a neoclassical growth model with the monetary approach to the balance of payments, is one example of such an integrated framework. 2/

While simplicity makes a model more tractable from an operational standpoint, it nonetheless has several drawbacks due to the necessarily restrictive assumptions it employs. This paper assesses the usefulness of this model for policymaking by examining empirically the tradeoff between its simplifying assumptions and its ability to fit reality. This tradeoff can be assessed by applying the model to a variety of countries. For each country considered it is possible to ask the following questions: (a) Are the key parameters of the model stable? (b) How sensitive are the policy multipliers to these parameter estimates --that is, how robust are the policy implications? and (c) Are some target variables more vulnerable to forecast errors than others?

This paper examines these questions for a diverse sample of seven capital-importing developing countries and, in doing so, attempts to reach some conclusions about the usefulness of the model to help in designing policy. The countries considered here are: Burma, Chile, Ghana, Honduras, Korea, Pakistan, and Tanzania. The sample thus includes low- and middle-income countries, manufacturing- and primary-exporters, as well as service and remittance countries, and one heavily-indebted country. This diversity makes the sample reasonably representative of developing countries in general.

1/ See the references contained therein, particularly Michalopolus. Khan (1987) also provides a broad survey of this literature.

2/ For a more detailed discussion of the building blocks of this model, see Khan, Haque, and Montiel (1986).

The remainder of this paper proceeds as follows: Section II provides a brief outline of the theoretical framework and examines its properties. The estimates of the key parameters of the model are described in Section III and the stability of a subset of these parameters is tested. Special attention is given to the adequacy of the model's specification of output determination, the demand for money, and private savings behavior. Section IV contains some comparative static exercises dealing with a variety of exogenous and policy-induced shocks, given the estimated parameter values. The shocks that are considered are at the center of most adjustment programs: devaluation, changes in domestic credit, and changes in government spending. 1/ This section concludes with an analysis of the "robustness" of the policy implications of the model under varying parameter values. The final section reviews the key results, discusses the limitations of the approach followed in this paper, and highlights some of the directions in which the theoretical and empirical work could be extended.

II. Summary of the Theoretical Framework

1. The key relationships

The model outlined in this section, which follows Khan and Montiel (1988), will serve as a benchmark for the subsequent empirical application. The model merges a growth block similar to that employed by the World Bank 2/ and a monetary block that is central to the monetary approach to the balance of payments associated with Fund-supported adjustment programs. 3/

The framework describes a small open economy, representative of a developing country, that maintains a fixed exchange rate. Equations (1) through (7) define the basic identities of the model, as well as the budget constraints for the private and public sectors. The private budget constraint:

$$(1) \qquad Y_t - T_t - C_t - S_{pt} \equiv 0;$$

The allocation of private savings:

$$(2) \qquad S_{pt} \equiv P_{Dt}\, dk_t + dM^d{}_t - dD_{pt};$$

1/ See, for instance, Khan and Knight (1985).
2/ See Khan, Montiel, and Haque (1986).
3/ See IMF (1977), (1987).

The government budget constraint:

(3) $e_t dF_t + dD_{gt} \equiv G_t + i_t e_t F_t - T_t - T_{Bt}$;

The sources of changes in the money stock:

(4) $dM^S{}_t \equiv e_{t-1} dR_t + dD_t$;

The composition of changes in domestic credit:

(5) $dD_t = dD_{gt} + dD_{pt}$;

Interest earnings on foreign reserves transferred to the government:

(6) $T_{Bt} = i_t e_t R_t$; and

Gross national product:

(7) $Y_t = Y_t - i_t e_t (F_t - R_t)$.

In order of appearance, the variables are defined as:

Y_t: Gross domestic product

T_t: Taxes from the private sector

C_t: Private consumption

S_{pt}: Private savings

P_{Dt}: Price of domestic output

dk_t: The change in the capital stock (=investment)

dD_{pt}: The change in domestic credit to the private sector

dD_{gt}: The change in domestic credit to the public sector

G_t: Government purchases of domestic output

F_t: Foreign currency value of government foreign debt

i_t: Interest rate on foreign debt

e_t: Nominal exchange rate--number of domestic currency units per unit of foreign currency

$dM^S{}_t$: Change in the money stock

R_t: Foreign currency value of reserves held by the central bank

dD_t: The change in total domestic credit

T_{Bt}: Interest earnings on foreign reserves transferred to the government

The "d's" denote changes from time t-1 to time t, i.e., $dx_t=x_t-x_{t-1}$.

The centerpiece of the growth block of the model is a neoclassical production function. Capacity, or potential growth, depends on increases in total factor productivity, changes in the size of the labor force, and in the capital stock. Combining technologically-driven productivity changes and changes in labor supply into one exogenous variable 1/, the production function takes the following form:

$$(8) \qquad dy_t = \alpha_0 + \alpha_1 dk_t$$

where the lower case letters denote real magnitudes. The coefficient of investment, α_1, is the marginal product of capital, and the constant term, α_0, denotes the combined effects total factor productivity and the change

1/ These are combined for simplicity in the theoretical model (as in Khan and Montiel, 1988). In the empirical work this assumption is relaxed.

in the size of the labor force. This production function specification is a more generalized version of the "incremental capital output *relationship" (ICOR).* 1/

The second behavioral relationship in the growth block describes private savings. It is assumed that real private savings is proportional to real disposable income:

$$(9) \qquad s_{pt} = s(y-t)_t; \quad 0 < s < 1$$

where s is a constant representing both the marginal and average savings rate.

The third building block of the growth model links savings identically to investment. Substituting the definition of the money stock, the government's budget constraint, and the savings function into (2), we obtain the following expression for the change in the capital stock:

$$(10) \qquad dk_t = s(y-t)_t + [t_t - g_t - ie(\frac{F-R}{P_{Dt}})] + e(\frac{dF-dR}{P_{Dt}})t$$

where the first term represents real private savings, the second real public saving, and the third is the real current account deficit (real foreign savings).

Since $y_t = y_{t-1} + dy_t$, and $P_{Dt} = P_{Dt-1} + dP_{Dt}$, we can express capacity growth as a function of domestic prices, reserves, and the exogenous variables and parameters:

$$(11) \quad dy_t = (1-s\alpha_1)^{-1} \{\alpha_0 + \alpha_1[s(y_{t-1}-t_t) + (t-g)_t + \frac{e(dF-dR-i[F-R])_t}{P_{Dt-1} + dP_{Dt}}]\}$$

1/ See Chenery and Strout (1966), Sato (1971), and Wai (1985).

The monetary block is also defined by three relationships 1/ starting with the flow supply of money:

$$(4) \qquad dM^S{}_t = e_{t-1}dR_t + dD_t$$

The second relationship is the flow demand for money, here simplified by the assumption that velocity is constant: 2/

$$(12) \qquad dM^d{}_t = \nu P_t dy_t + \nu y_{t-1} dP_t$$

where P is the aggregate price level, defined below, and ν is the inverse of the income velocity of money.

The last relationship in the monetary block determines money market equilibrium:

$$(13) \qquad dM^d{}_t = dM^S{}_t$$

Defining the change in the aggregate price level, dP_t, as a weighted average of the change in the price of importables, dP_{zt}, and the change in the price of domestic output, dP_{Dt}, with weights θ and $(1-\theta)$, respectively, we can write:

$$(14) \qquad dP_t = \theta dP_{zt} + (1-\theta)dP_{Dt}$$

Assuming that θ and the foreign-currency price of importables are constant, initial conditions are set so that, $e_0 = P_{z0} = P_{D0} = 1$ and that the law of one price holds, we obtain:

1/ See Robichek (1985).

2/ The underlying specification is $M^d{}_t = \nu P_t y_t$, with ν constant. This type of restrictive assumption is not essential to the model, as the analysis carries through with a more general specification.

(15) $dP_{zt} = P_D{*}_t de_t = de_t.$

Using (14), (15), and the definitions of flow money demand and supply, and substituting these back into the money market equilibrium condition (equation (13)), we arrive at an expression for the change in domestic prices as a function of output, reserves, the exogenous variables, and the parameters of the system:

$$(16)\quad dP_{Dt} = \{\nu(1-\theta)[y_{t-1} + dy_t]\}^{-1}\{dR_t - \nu dy_t - \nu\theta y_{t-1}de_t - \nu\theta de_t dy_t + dD_t\}.$$

2. The merged model

Combining the growth block, equation (10), with the monetary block, equation (16), does not close the system, as we have two equations in three unknowns, dy_t, dP_{Dt}, and dR_t. The additional relationship that enables this system to be fully determined is the balance of payments identity:

$$(17)\quad dR_t = X_t - Z_t - i(F-R)_t + dF_t,$$

where X_t and Z_t are the foreign currency value of exports and imports. Defining the trade balance in foreign currency terms, $B_t = Z_t - X_t$, it is assumed that:

$$(18)\quad B_t = B_0 - a(e_t/P_{Dt} - 1) + bdy_t$$

where a and b are positive constants; B_0 is constant whose sign is undetermined. Equation (18) implies that the trade balance improves in foreign currency terms when the real exchange rate depreciates ($e/P_D>1$) or when real output falls. 1/ Recalling that $F_t = F_{t-1} + dF_t$ and, similarly for R_t, equations (17) and (18) yield an expression for the change in reserves:

1/ Because imports (Z) decline in the latter case.

$$(19)\quad dR_t = (dF_t - B_0') + a'(e_t/P_{Dt} - 1) - b'dy_t - i'(F_{t-1} - R_{t-1}),$$

where $a'=a/(1-i)$, $b'=b/(1-i)$, $i'=i/(1-i)$, and $B_0'=B_0/(1-i)$.

Having obtained an expression for reserves, equation (19), the system can be solved in terms of equation (10), which summarizes the growth block, and equation (16), which summarizes the monetary block.

From the substitution of (19) into (10) we obtain:

$$(20)\qquad dy_t = [1 - s\alpha_1 - \alpha_1 b e_t/P_{Dt}]^{-1} \{\alpha_0 + \alpha_1 \{s(y_{t-1}-t_t) + (t-g)_t + \frac{e_t}{P_{Dt}} [B_0 - a(e_t/P_{Dt}-1)]\}\}.$$

Graphically, the growth block traces out the locus in Figure 1 that has been labelled GG. Its slope evaluated at $dy_t = dP_{Dt} = 0$ is:

$$\left.\frac{(dP_D)}{(dy)}\right|_{GG} = -\beta/\alpha_1\eta$$

where,

$\eta = B_0 - a$

and

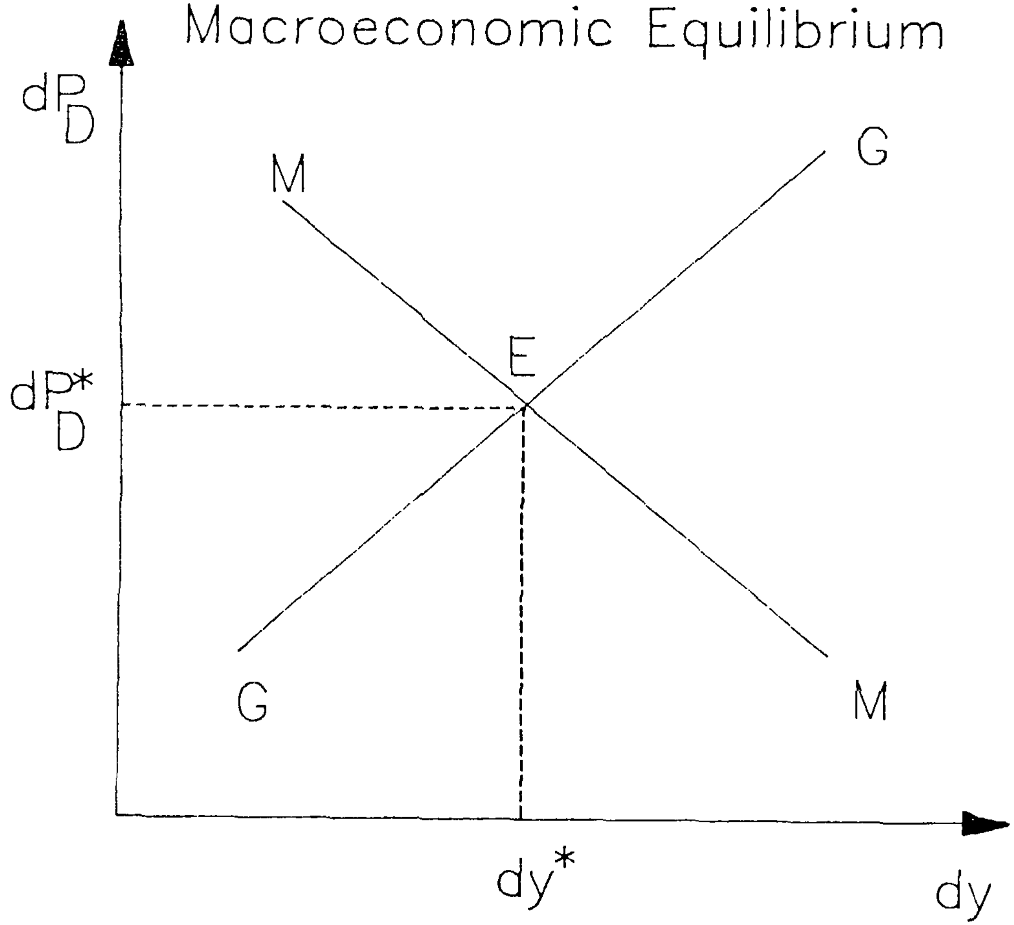
$\beta = 1 - \alpha_1(s + b) > 0$

If η is negative, the GG schedule is upwardly-sloped as depicted in Figure 1.

Similarly, substituting out reserves in the equation representing the monetary block, equation (16), we obtain:

$$(21)\qquad dP_{Dt} = \{\nu(1-\theta)(y_{t-1}+dy_t)\}^{-1} \{[dF_t - B_0' - i'(F_{t-1}-R_{t-1})+dD_t] -(b'+\nu)dy_t - \nu\theta y_{t-1}de_t - \nu\theta de_t dy_t + a'(e_t/P_{Dt}-1)\}.$$

Figure 1
Macroeconomic Equilibrium



With the exception of the production function, which includes a proxy for the labor force, the subsequent empirical work includes as explanatory variables only those variables dictated by the theoretical model. However, in general, the specifications of the estimation equations did allow these explanatory variables to appear with a richer lag structure than that suggested by the theoretical model. In each case the data determined the relevant lag pattern for the explanatory variables. The specific details for each equation and for each country are outlined in the remainder of this section.

2. How well can a production function explain output growth?

To obtain estimates for the marginal product of capital, α_1, and the combined effects of changes in the size of the labor and total factor productivity, α_0, we began by estimating a simple growth model that is derived from an aggregate neoclassical production function. As in Robinson (1971), IMF (1988), and Khan and Reinhart (1989), the growth function estimated takes the form:

$$(8a) \qquad Dy_t = \alpha_0 + \alpha_1(dk_t/y_{t-1}) + \alpha_2 DL_t$$

where the upper case D's indicate rates of change and L denotes the labor force, here proxied by population. Because the data was allowed to determine the lag pattern for the investment-output ratio, the particular form that (8a) assumed for each country is presented in Appendix II. The estimates presented in Table 3 were obtained by applying OLS to an equation such as (8a) and imposing constant returns to scale, so that $\alpha_2=(1-\alpha_1)$.

This exercise has a twofold purpose: first, it yields the relevant parameter estimates; second, it serves as a "test" of the usefulness of an aggregate production function in explaining actual output growth. As Table 2 highlights, the estimates for the marginal product of capital are reasonable in sign and magnitude across countries, averaging about 0.29 1/ (these are the parameter values that will be used in the subsequent comparative static exercises). Unfortunately, however, a neoclassical production function does not explain much of the variation in actual output. One possible explanation for the large proportion of output variation that remains unexplained is that, in effect, the specification traces out a production possibility frontier--in reality, a significant number of countries, particularly developing countries, are not operating

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1/ This average is higher than the 0.2 value obtained by Khan and Reinhart (1989) for a cross-section sample of 24 developing countries, but in line with Tyler (1981), who obtained a value of 0.25. Balassa (1978) found the marginal product to be about 0.16.

Table 2. Production Functions: How Well Can These Explain Output Growth?

	Country						
	Tanzania	Ghana	Pakistan	Korea 1/	Burma	Honduras	Chile
α_0	-.07	-.04	-.07	.08	-.02	-.05	-.07
t-stat.	(-2.25)	(-1.06)	(-1.35)	(6.94)	(-.66)	(-2.10)	(-2.61)
α_1	.28	.12	.62	.08	.23	.28	.50
t-stat.	(2.60)	(1.79)	(5.01)	(2.58)	(2.61)	(2.01)	(6.08)
R^2	.28	.14	.71	.34	.17	.13	.79
D.W.	1.81	1.40	1.51	1.12	1.38	1.27	2.83

1/ The investment-output ratio has been de-trended.

at full capacity. As such, a host of macro- and microeconomic factors, not embodied in the production function, can push actual output growth towards or away from its potential. While this variation of the ICOR meets the criteria of simplicity, which makes it applicable even in countries with limited data availability, it has the considerable drawback of being unstable over time. Projections of output growth based on variants of a production function are routinely subject to large and variable errors and, yet, a neoclassical production function is one the key relationships of the "growth block" of the theoretical framework.

Given the empirical inadequacy of the "full capacity" assumption, one possible route for future research would be to incorporate the existence of persistent excess capacity (present in varying degrees in most developing countries). By so doing, the theoretical model would allow domestic and foreign "demand" variables to play a greater role in output determination. Empirically, this extension should help reduce the share of output fluctuations that remains unexplained.

3. Savings behavior--Is the savings rate constant?

The second behavioral relationship in the model's growth block is the specification of the personal savings rate. The theoretical model assumes that real private savings is proportional to real disposable income. Variables that proxy the private sector's rate of time preference are not included in this specification. Similarly, other scale variables, such as wealth, are also omitted. 1/

The presence of negative levels of private savings for some of the countries in the sample for a subset of the years in which the data is available ruled out estimating a log linear savings function. Furthermore, the problem of hetereoskedastic errors makes the use of levels inappropriate.

Equation (9), however, implies that the marginal and average savings rates are equal. We proceed to use the average private savings rate, reported in Table 3, as our measure of s. 2/ While this average provides numerical values for the savings parameter, it says nothing about the adequacy of assuming a constant stable savings rate. To assess the properties of savings behavior, in particular its stability, given the aforementioned obstacles, we focused on consumption behavior. Table 4 reports the results of an equation of the form:

$$(21) \qquad Dc_t = c_0 + c_1 D(y-t)_t$$

1/ For example, the role of wealth in consumption is emphasized in Haque and Montiel (1989).

2/ The construction of this variable is explained in Appendix I.

Table 3. The Savings Rate 1/

	Country						
	Tanzania	Ghana	Pakistan	Korea	Burma	Honduras	Chile
Average	0.03	-0.25	0.07	0.31	0.16	0.21	-0.06
Is the Savings Rate Constant?							
Unconstrained Equation							
c_0	0.02	0.04	0.01	0.03	-0.01	0.04	-0.04
t-stat	(0.49)	(1.02)	(0.08)	(0.94)	(-0.52)	(2.78)	(-1.73)
c_1	0.76	0.79	1.02	0.82	1.06	0.61	1.07
t-stat	(3.01)	(8.41)	(10.70)	(5.40)	(14.86)	(4.15)	(31.82)
R^2	0.32	0.79	0.86	0.60	0.92	0.48	0.99
D.W.	1.42	1.98	1.94	1.34	1.87	1.31	1.78
Unconstrained							
S.S.E.	0.152	0.211	0.017	0.043	0.020	0.015	0.023
Constrained							
S.S.E.	0.166	0.284	0.017	0.047	0.021	0.022	0.033
F-stat	0.62	3.08	0.21	0.91	0.26	3.72	1.98

1/ The sample period is 1963-86, except for Chile in which a 1973-86 sample is used.

where c represents real private consumption, c_0 is a constant term, c_1 is the average propensity to consume, and the D's indicate rates of change. The results of (21) were used to test the assumption of a constant savings rate. If the savings rate is constant, then the null hypothesis of $c_0=0$ and $c_1=1$ should hold in the data. In other words, to maintain the savings rate constant, income and consumption would have to increase at equal rates. This test of stability was preferred over the more traditional approaches, such as the Chow test, because in many instances splitting the sample was not advisable, given the limited number of observations available.

The results of an F-test comparing the residuals of the unconstrained, (21), and constrained equations indicate that only in one out of the seven countries in the sample was the savings rate found to be variable, making the assumption of a constant and stable savings rate reasonable for most instances. In effect, the constrained equation imposes the condition that the savings rate is stable while the unconstrained does not. If the savings rate is indeed unstable, then imposing the constraints would generate large errors relative to the errors of an unconstrained specification and this would be apparent in the F-tests that compare the two versions of (21). The drawback of this test is that, even if the savings rate is found to be unstable, as in the case of Honduras, this result could stem from misspecification--in particular the omission of the real rate of interest, not from behavioral instability. If the interest rate belongs in the savings function, as several studies would suggest, 1/ then the constant term in a specification such as (21) could simply be picking up the systematic influence of the omitted variable.

4. Money demand--Is velocity constant?

Having obtained estimates for the three parameters that describe the "growth block" of the model and having evaluated the relative merits of the assumptions that underscore that portion of the merged model, we proceed to do the same for the monetary sector. The key behavioral relationship is the specification of money demand. As equation (14) indicates, it is assumed that opportunity cost variables do not affect the demand for money, hence the income velocity of money is taken to be a constant. 2/

As with the savings parameter, the historical averages of the ratio of money to income are used to approximate ν, the inverse of the income velocity of money. These averages for both narrow and broad definitions of money are reported in Table 4.

To "test" the validity of the constant velocity assumption, we begin with a generalized version of (14) which: (a) includes a constant term, (which under the null hypothesis of constant velocity should be insignif-

1/ See Rossi (1988).
2/ This is, of course, an extreme assumption.

Table 4. Velocity Behavior

	Country						
	Tanzania	Ghana	Pakistan	Korea	Burma	Honduras	Chile
<u>Money Plus Quasi Money</u>							
Average	0.31	0.25	0.37	0.31	0.29	0.21	0.22
<u>Narrow Money</u>							
Average	0.24	0.19	0.25	0.10	0.25	0.11	0.07
<u>Is Velocity Constant</u>?							
<u>Money plus Quasi Money</u>							
Unrestricted							
d_0	0.11	0.14	0.14	0.11	0.06	0.12	0.17
t-stat	(1.87)	(3.35)	(5.25)	(1.23)	(2.09)	(4.72)	(1.81)
d_1	0.77	0.39	0.53	0.70	0.29	0.57	0.09
t-stat	(1.27)	(0.90)	(1.34)	(1.17)	(0.62)	(1.50)	(0.13)
d_2	0.25	0.41	-0.32	0.57	0.32	-0.13	0.84
t-stat	(1.07)	(3.87)	(-1.50)	(1.62)	(1.61)	(-0.68)	(7.83)
R^2	0.10	0.42	0.16	0.17	0.12	0.13	0.88
D.W.	2.10	1.57	2.02	0.91	1.18	1.78	1.46
Restricted $(d_1=d_2)$							
d_0	0.13	0.14	0.16	0.11	0.06	0.13	0.15
t-stat	(2.58)	(3.45)	(5.69)	(1.29)	(2.26)	(5.60)	(1.60)
d^1	0.23	0.41	-0.13	0.60	0.32	-0.03	0.86
t-stat	(0.98)	(3.96)	(-0.66)	(2.10)	(1.72)	(-0.16)	(8.15)
R^2	0.05	0.42	0.02	0.17	0.12	0.00	0.87
D.W.	1.99	1.57	1.92	0.90	1.20	1.77	1.86
<u>Narrow Money</u>							
Unrestricted							
d_0	0.07	0.11	0.14	0.10	0.03	0.08	0.08
t-stat	(0.93)	(2.52)	(4.87)	(1.29)	(0.78)	(2.92)	(1.01)
d_1	1.06	0.38	0.69	0.48	0.26	0.74	0.20
t-stat	(1.33)	(.79)	(1.73)	(0.92)	(0.46)	(1.82)	(0.32)
d_2	0.37	0.50	-0.40	0.47	0.62	0.07	0.82
t-stat	(1.20)	(4.22)	(-1.86)	(1.54)	(2.54)	(0.35)	(8.15)
R^2	0.11	0.46	0.23	0.14	0.25	0.14	0.91
D.W.	2.06	1.62	1.29	1.78	1.71	2.05	1.73
Restricted $(d_1{}^{-}d_2)$							
d_0	0.10	0.11	0.15	0.10	0.02	0.09	0.07
t-stat	(1.53)	(2.56)	(5.64)	(1.33)	(0.62)	(0.37)	(0.81)
d^1	0.33	0.50	-0.15	0.48	0.57	0.17	0.84
t-stat	(1. 1.11)	(4.31)	(-0.73)	(1.89)	(2.52)	(0.82)	(9.18)
R^2	0.06	0.46	0.02	0.14	0.23	0.03	0.89
D.W.	1.95	1.65	1.74	1.78	1.81	2.01	2.27

icantly different from zero); and (b) does not restrict the coefficients of output and prices to be identical, allowing for the presence of economies of scale in cash balances. This generalized specification is equation (14a),

$$DM_t = d_0 + d_1 Dy_t + d_2 DP_t \qquad (14a)$$

where d_0 is a constant term that represents $D(1/\nu)$, the rate of change in income velocity. This equation was estimated over the seven countries in the sample (using both narrow and broad definitions of money) with and without imposing the restriction that $d_1 = d_2$. The results are presented in Table 5. At one end are Korea and Chile with an insignificant constant term in all specifications indicating that our null of no change in velocity cannot be rejected. At the other end of the spectrum, for Ghana and Pakistan all specifications indicate that velocity is not constant. More generally, it appears that it easier to reject the null hypothesis of constant velocity for broad definitions of money (five out of seven countries) than for narrowly defined money (only two out of seven). 1/ The almost uniform poor fit of (14a) is another indication of the variability of velocity changes since, in the cases where the rate of change in velocity is constant, (14a) would be an identity.

As with the savings rate these results must be interpreted with care. The above results do not imply widespread instability in the demand for money, but rather suggests that a specification such as (14) is likely to be too restrictive. In particular, it seems reasonable to expect that a developing country, becoming increasingly monetized over time, would show secular changes in the income velocity of money. The significance of the constant term in many of the specifications presented in Table 5 may well arise from these institutional changes as well as from omission of other explanatory variables such as the nominal interest rate, inflationary expectations, and exchange rate changes. However, the results do indicate that future extensions to the theoretical and empirical work should include more comprehensive specifications of money demand. In summary, the assumption of constant velocity, like the assumption of fully employed resources in the growth block, appears to be a weak link in the unified model.

The remaining parameter in the monetary component of the model is θ, the weight of import prices in the general price level. This parameter was approximated by average share of imports in total (public plus private) consumption and is reported in Table 5.

1/ We reject when both restricted and unrestricted versions coincide.

Table 5. Approximating the Weight of
Import Prices In the Aggregate Price Level

	Country						
	Tanzania	Ghana	Pakistan	Korea	Burma	Honduras	Chile
Share $\approx \theta$	0.252	0.114	0.158	0.181	0.096	0.306	0.201

5. <u>The trade balance</u>

Two external-sector relationships close the system: the balance of payments identity, equation (17), and the trade balance responses to output and real exchange rate changes, equation (18). These two remaining parameters (in the trade balance equation) to be estimated link the "real" and "monetary" sectors. The remainder of this section outlines how estimates for the parameters a and b were obtained. Because the trade balance changes in sign across countries and across time, a log-linear version of (18) cannot be estimated. Also to avoid the problem of hetereoskedastic errors, the use of levels was deemed inappropriate. Instead, the trade balance was decomposed into its components--exports and imports. The relative price and income elasticities of import demand and export supplies were estimated using some variant of:

$$(22) \qquad \log(z_t) = \delta_0 + \delta_1 \log(y_t) + \delta_2 \log(P_{zt}/P_{Dt})$$

for imports; and

$$(23) \qquad \log(x_t) = \epsilon_0 + \epsilon_1 \log(yf_t) + \epsilon_2 \log(P_{xt}/P_{Dt})$$ 1/

1/ The use of the relative price of exports, P_x/P_D, in this specification in lieu of the real exchange rate, P_z/P_D, is justified by the assumption of constant terms of trade in the theoretical model.

for exports. In the export demand function, yf denotes real GDP of the industrial countries. The specific form equations (22) and (23) assumes for each country varies according to the lag pattern the data reveals. These details are relegated to Appendix II.

Proxies for a and b were constructed by weighting the "disaggregated" parameter estimates (obtained by applying GLS to the above equations) by the sample period averages of imports and exports, respectively. The results of the estimation of import demand and export supply as well as the derivation of the relevant weights are reported in Appendix II, while the "weighted" estimates for a and b are reported in Table 6. In all seven countries, the real exchange rate elasticity, -a, has the correct sign (negative), and in all cases, an increase in domestic income worsened the trade balance--i.e., b is positive.

Having obtained estimates for all the parameters that characterize the theoretical model and highlighted the weaknesses of some of the key assumptions, we proceed to evaluate the policy implications of the model and assess the robustness of those implications.

IV. Comparative Statics and Sensitivity Analysis

1. Summary of findings in the cross-country comparisons

Parametrizing the model is useful in comparing it's ability to fit diverse circumstances, but is only an intermediate step in evaluating the model's usefulness for policymaking. The purpose of this section is to construct the policy multipliers associated with the estimated parameter values and address two related issues. First, we examine the sensitivity of these multipliers to varying parameter values--the policy robustness question; second, we assess the relative precision of the forecasts for the target variables.

Table 7 summarizes the point estimates of the parameters of interest, and it is these values that generate the "core" set of policy multipliers. However, as Table 8 shows, only limited confidence can be placed on these point estimates since some of the parameters are unstable. Even in the instances in which the hypothesis of stability cannot be rejected, the precision of these point estimates tends to be quite low (i.e., the standard errors tend to be large). This suggests that, for any analytical purposes, a band of parameter values must be considered. The upper and lower bounds of such a band were calculated by respectively adding and subtracting one-half a standard error to the point estimates.

Figure 2 illustrates the configuration of the real and monetary sectors that the averages from our sample suggest. The actual numerical values of the slopes of the GG and MM schedules (and the range defined by the parameter band) are presented in Table 9 for the sample countries. The remainder of this section considers three policy exercises: an increase in domestic credit; an increase in government spending; and a

Table 6. The External Sector Parameters

	Country						
	Tanzania	Ghana	Pakistan	Korea	Burma	Hondura	Chile
Weighted real exchange rate elasticities							
Imports	-0.89	0.12	-1.38	-4.92	-0.38	-0.05	-3.2
Exports	0.09	0.31	-0.56	3.73	0.37	0.22	-0.26
Trade Balance Effect	-0.98	-0.20	-0.81	-8.65	-0.75	-0.26	-2.3
As a share of the "External" Sector 1/	-0.37	-0.08	-0.21	-0.83	-0.40	-0.12	-0.59
Weighted income elasticities							
	0.69	1.20	1.00	0.64	0.62	1.28	1.81

1/ To make the weighted elasticities comparable across countries these were scaled by the size of the external sector, here measured as the sum of average imports and exports (see Appendix).

Figure 2
The Parametrized System

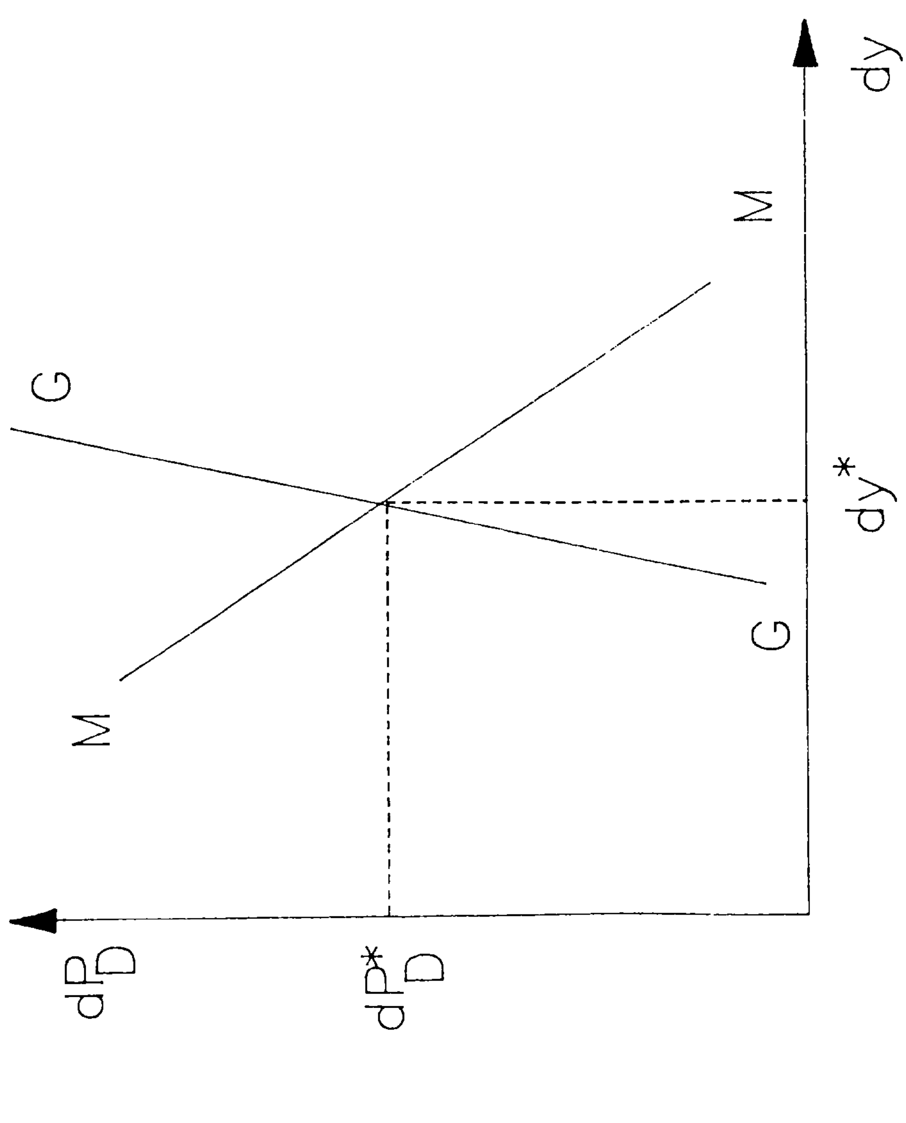

Table 7. Cross-Country Comparison of the Key Parameters

	Country							
	Tanzania	Ghana	Pakistan	Korea	Burma	Honduras	Chile	Average
α_0	-0.07	-0.04	-0.07	0.08	-0.02	-0.05	-0.07	-0.03
α_1	0.28	0.12	0.62	0.08	0.23	0.28	0.50	0.29
s	0.03	-0.25	0.07	0.31	0.16	0.21	-0.06	0.07
ν 1/	0.31	0.25	0.37	0.31	0.29	0.21	0.22	0.28
θ	0.25	0.11	0.16	0.18	0.10	0.31	0.20	0.19
a	-0.37	-0.08	-0.21	-0.83	-0.40	-0.12	-0.59	-0.37
b	0.69	1.20	1.00	0.64	0.62	1.28	1.81	1.03

1/ Uses the broad definition of money, money plus quasi-money.

Table 8. Testing the Assumptions of the Model

	Country						
	Tanzania	Ghana	Pakistan	Korea	Burma	Honduras	Chile
<u>Can we reject constant velocity</u>?							
broad	no	yes	yes	no	yes	yes	no
narrow	no	yes	yes	no	no	no	no
<u>Can we reject a constant savings rate</u>?							
	no	no	no	no	no	yes	no
<u>What percentage of output variation is explained by a production function</u>?							
	22	28	74	34	20	9	91

Table 9. The Graphics of the Empirical Model

	Country							
	Tanzania	Ghana	Pakistan	Korea	Burma	Honduras	Chile	Average
Slope of the GG schedule								
Point est.	7.9	76.9	2.7	16.2	9.2	18.6	0.4	18.8
Lower Bound	10.8	82.2	4.5	16.0	9.8	32.1	1.4	22.5
Upper Bound	5.6	71.6	1.3	16.4	8.7	9.4	0.1	16.0
Slope of the MM schedule								
Point est.	-1.7	-4.8	-2.6	-0.9	-1.4	-5.6	-2.7	-2.8
Lower Bound	-1.5	-4.1	-2.6	-0.8	-1.1	-4.9	-2.5	-2.5
Upper Bound	-1.8	-5.3	-2.6	-0.9	-1.6	-6.0	-2.8	-3.0

devaluation. Since the model is static, we evaluate the effects of policy by comparing the pre-shock and post-shock steady states--that is, we calculate the relevant policy multipliers.

In all cases considered, we assess the sensitivity of these multipliers to changing parameter values. The policy implications of the model are said to be robust if the range of values assumed by the multiplier remains narrow despite changes in the parameters. This section concludes with a discussion of the relative predictability of the target variables.

2. An increase in domestic credit

An increase in the rate of domestic credit expansion (here we assume that the increase in credit goes entirely to the private sector) creates a *flow excess supply of money on impact. In Figure 2, this shifts the* MM schedule upward. At the initial level of output, this induces an increase in the price level which, in turn, increases money demand. However, for a given level of import prices, the domestic price rise also produces a real exchange rate appreciation and a worsening in the current account deficit. The worsening current account is mirrored in an increase in foreign savings and an increase in investment and output growth. Ultimately inflation rises, output growth increases, and the balance of payments worsens. 1/

More formally, the increase in inflation is given by:

$$\frac{\partial(dPD)}{\partial(dD)} = (\Omega\gamma)^{-1} > 0$$

$$\Omega = 1 - \frac{\alpha_1 \eta(b' + \nu)}{\beta\gamma} > 0$$

and as before,

$$\beta = 1 - \alpha_1 (s + b) > 0$$

$$\eta = B_0 - a$$

1/ See Khan and Montiel (1988) for a detailed discussion.

The change in output growth is:

$$\frac{\partial(dy)}{\partial(dD)} = - \frac{\eta\alpha_1}{\beta} (\Omega\ \gamma)^{-1} \quad > 0$$

and the change in the balance of payments is:

$$\frac{\partial(dR)}{\partial(dD)} = \frac{(b'\alpha_1\ \eta\ -\ a')}{\beta} (\Omega\gamma)^{-1} \quad < 0$$

Using the estimated parameter values and the corresponding parameter bands, the multipliers for the three target variables are reported in Table 10. As an example, in the sample average case, a ten percent increase in the rate of growth of credit increases inflation by about 15 percent (the range is 12 - 19 percent), increases output growth by two percent, and worsens the balance of payments by six percent.

Note the large discrepancy between the inflation multipliers, which are highly variable in most instances, and the relatively close values for multipliers for growth and the balance of payments. This suggests that the usefulness of the model, and/or the desirability of using credit as a policy instrument, will depend, to a large degree, on the form of the policymakers' objective function. If the primary objective of policy is to meet an inflation "target", then this framework of analysis, given the underlying parameter values, may not be the best to employ. If on the other hand the primary policy objective is a balance of payments or growth target the model is more useful.

3. <u>An increase in government spending</u>

An increase in government spending, maintaining taxes and the rate of change in domestic credit at initial levels, shifts the GG schedule in Figure 2 to the left. The rise in fiscal spending translates into a higher deficit and, therefore, less public savings. The decline in savings reduces capital accumulation and output growth. As output growth falls, reducing the flow demand for money and creating an excess supply, inflation must rise to ensure the money market clears. With output falling and prices rising, the impact of the fiscal expansion on the balance of payments is theoretically ambiguous and must be determined by the data. The effects of a change in real government spending on

Table 10. A Ten Percent Increase in Domestic Credit 1/

(Percent)

	Country							
	Tanzania	Ghana	Pakistan	Korea	Burma	Honduras	Chile	Average
The inflation multiplier 2/								
Point est.	13.5	31.3	9.7	8.8	13.1	28.7	1.8	15.3
Lower Bound	15.3	37.8	12.8	9.2	14.1	36.3	4.8	18.6
Upper Bound	11.7	26.4	5.9	8.4	12.1	20.2	0.8	11.8
The output multiplier 3/								
Point est.	1.7	0.4	3.6	0.5	1.4	1.5	4.2	1.9
Lower Bound	1.4	0.5	2.8	0.6	1.4	1.1	3.5	1.6
Upper Bound	2.1	0.4	4.6	0.5	1.4	2.2	5.2	2.3
The balance of payments multiplier 4/								
Point est.	-6.2	-3.0	-5.6	-7.6	-6.1	-5.4	-8.7	-6.1
Lower Bound	-6.4	-3.4	-5.3	-8.0	-6.3	-5.5	-8.6	-6.1
Upper Bound	-6.1	-2.7	-6.2	-7.3	-6.0	-5.8	-9.1	-6.2

1/ The upper and lower bounds refer to adding and subtracting (respectively) one-half a standard deviation to the underlying structural parameters--not to the multipliers themselves.
2/ $\partial(dP_D)/\partial(dD)$
3/ $\partial(dy)/\partial(dD)$
4/ $\partial(dR)/\partial(dD)$

inflation growth and the balance of payments are listed below while Table 11 summarizes the relevant set of policy multipliers.

$$\frac{\partial(dP_D)}{\partial g} = \Omega^{-1} \frac{\alpha_1 (b' + \nu)}{\beta\gamma} > 0,$$

$$\frac{\partial(dy)}{\partial g} = - \Omega^{-1} \alpha_1/\beta < 0,$$

and

$$\frac{\partial(dR)}{\partial g} = \frac{\alpha_1}{\beta} \Omega^{-1} [b' - a' (b' + \nu) \gamma] \gtreqless 0$$

Once again the fiscal multipliers for output and the balance of payments are bounded by a fairly narrow range. In the case of a change in credit--a monetary shock--the bulk of the adjustment fell on the nominal variable (inflation) with output growth and the balance of payments remaining relatively unaffected. This result is not surprising, given the very steep GG schedules that the estimated parameter values trace out. What is more surprising is that a change in government spending--a real shock, also has a greater impact (and more variable) on inflation than on the real variables. It was also found that for all seven countries the balance of payments improved after the shock, indicating that the contractionary output effect dominated the relative price effect.

4. Devaluation

A devaluation is both a real and nominal shock, and consequently shifts both schedules in Figure 2. At the initial price of domestic goods, a devaluation increases the aggregate price level via an increase in the price of imports. This increases the flow demand for money. At the same time, the shift in relative prices induces lower consumption of the importable and higher production of the domestic good, leading to an improvement in the balance of payments and an expansion in the flow supply of money. If substitution effects are dominant then the increase in the flow supply of money more than accommodates the rise in demand and the MM schedule shifts to the right--this effect is expansionary. In the "real" sector the foreign component of savings is lower, due to the improvement in the balance of payments, this reduces capital formation shifting the GG schedule to the left--a contractionary effect. As shown in Khan and

Table 11. A Ten Percent Increase in Government Spending 1/

(Percent)

	Country							
	Tanzania	Ghana	Pakistan	Korea	Burma	Honduras	Chile	Average
The inflation multiplier 2/								
Point est.	4.8	6.1	24.4	0.7	3.3	20.6	14.6	10.7
Lower Bound	3.3	5.0	18.0	0.7	2.6	11.8	10.9	7.5
Upper Bound	6.8	7.2	33.4	0.8	4.1	35.0	19.4	15.2
The output multiplier 3/								
Point est.	-2.9	-1.3	-9.3	-0.8	-2.4	-3.7	-5.5	-3.7
Lower Bound	-2.2	-1.2	-7.0	-0.8	-2.4	-2.4	-4.3	-2.9
Upper Bound	-3.7	-1.4	-12.7	-0.8	-2.5	-5.8	-7.0	-4.8
The Balance of Payments multiplier 4/								
Point est.	0.2	1.0	4.2	-0.1	0.2	2.3	1.4	1.3
Lower Bound	0.1	0.6	2.7	-0.1	-0.1	1.0	0.8	0.7
Upper Bound	0.6	1.5	6.5	-0.1	0.4	4.9	2.2	2.3

1/ The upper and lower bounds refer to adding and subtracting (respectively) one-half a standard deviation to the underlying structural parameters--not to the multipliers themselves.
2/ $\partial(dP_D)/\partial(g)$
3/ $\partial(dy)/\partial(g)$
4/ $\partial(dR)/\partial(g)$

Montiel (1988), the latter effect dominates and output falls. Table 12 presents numerical multipliers of a devaluation, the partial derivatives are listed below:

$$\frac{\partial(dP_D)}{\partial(de)} = (\Omega\gamma)^{-1}\ [a' - \nu Y_0\ \theta - \alpha_1\eta(b' + \nu)/\beta]\ > 0$$

for growth:

$$\frac{\partial(dy)}{\partial(de)} = \frac{\alpha_1\eta}{\beta}\ (\Omega\gamma)^{-1}\ \nu Y_0\ < 0$$

and the balance of payments

$$\frac{\partial(dR)}{\partial(de)} = (a' - b'\ \frac{\alpha_1}{\beta}\ \eta)(\Omega\gamma)^{-1}\ \nu Y_0 > 0$$

Two general characteristics are worth noting: first, the multipliers of a devaluation are relatively low when compared to those associated with credit and fiscal changes, suggesting it takes large devaluations to impact the target variables in any meaningful way; second, as with monetary and fiscal policy, although not quite as pronounced, the effects of a devaluation on inflation are greater than the output or balance of payments effects, indicating that the desirability of either employing this framework, using devaluation as a policy tool, or both, will depend on the relative importance of the inflation target in the overall objective function of the policymakers.

V. Conclusions

The objective of this paper was to apply to a diverse group of developing countries a model that, in principle is: (a) simple enough to be used operationally in countries where data availability is limited and, (b) comprehensive enough to enable a useful analysis and evaluation of growth-oriented policies to be undertaken.

Table 12. A Ten Percent Devaluation 1/

(Percent)

	Country							
	Tanzania	Ghana	Pakistan	Korea	Burma	Honduras	Chile	Average
The inflation multiplier 2/								
Point est.	5.7	2.2	6.4	7.3	6.1	3.9	9.6	5.9
Lower Bound	5.9	2.9	5.8	7.8	6.4	4.0	9.1	6.0
Upper Bound	5.6	1.6	7.5	6.8	6.0	4.6	10.5	6.1
The output multiplier 3/								
Point est.	-0.4	-0.1	-0.9	-0.1	-0.3	-0.2	-0.3	-0.3
Lower Bound	-0.3	-0.1	-0.7	-0.1	-0.3	-0.1	-0.2	-0.3
Upper Bound	-0.5	-0.1	-1.2	-0.1	-0.4	-0.3	-0.4	-0.4
The Balance of Payments multiplier 4/								
Point est.	1.9	0.7	1.7	2.3	1.8	1.0	0.8	1.4
Lower Bound	1.7	0.6	1.5	1.9	1.6	0.8	0.9	1.3
Upper Bound	2.1	0.8	1.8	2.7	1.9	1.1	0.6	1.6

1/ The upper and lower bounds refer to adding and subtracting (respectively) one-half a standard deviation to the underlying structural parameters--not to the multipliers themselves.
2/ $\partial(dP_D)/\partial(de)$
3/ $\partial(dy)/\partial(de)$
4/ $\partial(dR)/\partial(de)$

The first step of this evaluation process was to estimate the model and test its underlying assumptions. The estimated parameter values were in accordance with the theoretical priors, but we identified two weak building blocks in the framework: that output is assumed to expand at a technology- and endowment-determined rate, and, that the income velocity of money is assumed to be constant. The low explanatory power of a neo-classical production function suggests that future extensions to this framework should attempt to incorporate the presence of excess capacity, which characterizes most developing countries. Similarly, the empirical variability in velocity indicates the need for a less restrictive specification of money demand that allows for the secular effects of monetization in developing economies as well as for the impact a variety of opportunity cost variables. Lastly, the model is static and consequently, does not incorporate the possibility of slow adjustment and the role of expectations in the analysis.

The second part of the evaluation process involved using the estimated parameter values to construct reduced form multipliers and analyze the effects of a variety of policy exercises. Here, we found that the robustness of the model's policy implications depend heavily on two factors.

First, "robustness" depends on which of the target variables are being considered--for output growth and the balance of payments the range for multipliers is narrow, despite sizable variation in parameter values. For inflation, the range of values the policy multipliers assume are quite broad. This suggests that, more likely than not, the forecast errors are bound to be large if this model is employed to forecast the effects of policy changes on inflation. So, in effect, the usefulness of this model for policymaking (given the parameter values) will depend crucially on the policymaker's objective function. In general, the model is less useful if the primary objective of policy is to meet an inflation target. If on the other hand, the balance of payments or growth are the principal targets, then the projected outcomes suggested by this model are more useful.

Second, the reliability of the policy implications depends on the policy instrument being considered. From the multipliers calculated in the paper, it is evident that effects of a devaluation (on all target variables) are less sensitive to parameter changes than the multipliers of changes in credit or fiscal policies.

While some possible extensions to the theoretical framework have already been mentioned, there are a number of ways in which the empirical work can be enriched. In particular, when maintaining a consistent methodology across countries is not a binding constraint, as it was in this paper, more efficient use can be made of the greater data availability in some countries. This would allow for more rigorous tests of parameter instability. It would also enable the estimation of the model as a system and a more formal assessment of forecasting errors.

In conclusion, the present model is a useful starting point for the design of growth-oriented policies, although its usefulness across countries is by no means uniform. There are countries where none of the theoretical assumptions appear to be adequate--Honduras--and where, consequently, the effects of macroeconomic policies suggested by the model are subject to a large degree of uncertainty. There are countries where the assumptions appear to have greater empirical validity--Korea and Chile--and the policy implications are relatively more robust. In general, this analysis would indicate that a reasonable next step in enhancing the operational usefulness of basic model would be to relax some of the more rigid assumptions, while attempting to keep the added degree of complexity to a minimum.

Data Definitions and Sources

a. IMF, International Financial Statistics; and
b. IMF, World Economic Outlook.

The definition of the variables used in the estimations are, in order of appearance:

y_t: real GDP; source b.

dk_t/y_{t-1}: investment-output ratio; source b.

L_t: population; source b.

s: average private savings rate. Constructed by subtracting government savings from gross savings; sources a and b.

c_t: nominal private consumption deflated by the consumer price index; source b.

$(y-t)_t$: nominal GDP less nominal taxes deflated by the consumer price index; source b.

M_t: Nominal money stock--the analysis will indicate if narrow or broad money was used; source b.

P_t: consumer price index; source b.

z_t: nominal imports deflated by the unit value of imports; source b.

P_{zt}: unit value of imports; source b.

P_{Dt}: GDP deflator; source b.

x_t: nominal exports deflated by the unit value of exports; source b.

P_{xt}: unit value of exports; source b.

yf_t: real GDP for industrial countries; source b.

1. Specification of the Production Function

The specification of (18a) for Tanzania and Honduras took the form of:

$$(18a_1) \qquad Dy = \alpha_0{*} + \alpha_1(dk/y_{-1}) + (1-\alpha_1)DL.$$

For the remaining countries, lagged values of the investment-output ratio were included along the lines outlined below:

$$(18a_2\text{-}4) \qquad Dy = \alpha_0{*} + \sum_{i=0}^{n} \alpha_i \, [(dk/y)_{-i}] + (1- \sum_{i=0}^{n} \alpha_i)DL.$$

For Burma and Chile; n, the number of lags included equals 1.
For Korea; n=2.
For Ghana and Pakistan; n=3.

2. Import and Export Demand Specifications

The generalized version of the estimated import demand equation is given by:

$$(22) \qquad \log(z) = \delta_0 + \delta_1\log(y) + \delta_2\log[(P_z/P_D)_{-i}]$$

For Pakistan, Korea, and Chile; i=0--no lag.
For Honduras; i=1.
For Burma; i=2.
For Tanzania and Ghana; i=3.

The generalized version of the estimated export supply equation is given by:

$$(23) \qquad \log(x) = \epsilon_0 + \epsilon_1\log(yf) + \epsilon_2\log[(P_x/P_D)_{-i}]$$

For Honduras and Chile; i=0.

For Ghana and Pakistan; i=1.
For Tanzania, Korea, and Burma; i=2.
Equation (23) also includes a time trend for Tanzania.

3. Deriving the Weights

To construct the price and income elasticities of the trade balance, B, from the estimates obtained by estimating import demand and export demand individually we proceeed as follows:

Since $dB = z\frac{dz}{z} - x\frac{dx}{x}$, $d[\log(z)] = \frac{dz}{z}$, $d[\log(x)] = \frac{dx}{x}$,

and recalling that the terms of trade, Px/Pz, is assumed constant in the theoretical model (and equal to one at t=0), we obtain,

$$dB = z\delta_1\frac{dy}{y} - x\epsilon_1\frac{dyf}{yf} - [\, z\delta_2 + x\epsilon_2 \,]\frac{d(Pz/PD)}{(P_z/P_D)} .$$

As usual the estimated elasticities are unit free, however, the relevant weights, z and x, are not. To make these weighted elasticities comparable accross countries the above was divided by the sum of imports and exports, z+x.

$$\frac{dB}{z+x} = \frac{z}{z+x}\delta_1\frac{dy}{y} - \frac{x}{z+x}\epsilon_1\frac{dyf}{yf} - [\frac{z}{z+x}\delta_2 + \frac{x}{z+x}\epsilon_2]\frac{d(Pz/PD)}{(P_z/P_D)} .$$

Table A1. Trade Parameters: Estimation Results

	Country						
	Tanzania	Ghana	Pakistan	Korea	Burma	Honduras	Chile
Import demand							
δ_0	-0.86	-8.42	-3.72	5.91	-3.56	-4.63	-13.29
t-stat	(-0.60)	(-1.94)	(-4.10)	(3.59)	(-2.00)	(-2.48)	(-5.01)
δ_1	0.78	1.76	1.07	0.68	0.93	1.79	2.27
t-stat	(2.68)	(2.39)	(8.27)	(5.51)	(2.43)	(3.04)	(8.33)
δ_2	-0.38	0.07	-0.36	-0.50	-0.30	-0.03	-1.00
t-stat	(-2.55)	(0.59)	(-3.09)	(-3.83)	(-0.71)	(-0.25)	(-4.70)
R^2	0.66	0.73	0.96	0.99	0.44	0.82	0.97
D.W.	2.06	1.61	1.71	1.71	1.72	1.54	1.29
Export supply							
ϵ_0	-6.70	2.93	-10.31	-28.48	-10.24	-9.20	-16.34
t-stat	(-0.65)	(1.23)	(-2.54)	(-4.99)	(-1.66)	(-4.68)	(-8.55)
ϵ_1	1.12	-0.18	1.68	4.41	1.35	1.31	2.56
t-stat	(0.83)	(-0.62)	(3.14)	(7.14)	(1.78)	(5.14)	(10.80)
ϵ_2	0.07	0.17	-0.22	0.39	0.32	0.15	-0.26
t-stat	(0.41)	(3.55)	(-1.05)	(1.69)	(1.31)	(0.84)	(-1.92)
R^2	0.81	0.68	0.74	0.98	0.41	0.68	0.97
D.W.	2.03	1.81	1.75	1.04	1.36	1.60	2.02

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